CLAIMS

1.   A method of generating a labeled image, including the steps of:

inputting a pixel block, which includes a plurality of pixels that are adjacent

5   to one another in more than one dimension, as a single unit from data including

pixels for forming an image; and

labeling, based on binarized pixels, all on-pixels or all off-pixels that are

subjects for grouping and are included in the pixel block with common

identification information.

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2.   The method according to Claim 1, wherein the pixel block is composed of

four pixels adjacent to one another in two dimensions or eight pixels adjacent to

one another in three dimensions.

15   3.   The method according to Claim 1, comprising:

a first stage of scanning the image, labeling with provisional identification

information, and generating connecting information for the provisional

identification information; and

a second stage of labeling with real identification information showing

20   image elements based on the connecting information,

wherein the first stage and the second stage each include the step of

inputting and the step of labeling,

in the step of labeling of the first stage, the provisional identification

information is the common identification information for labeling, and

25   in the step of labeling of the second stage, the real identification

information is the common identification information for labeling.

4.   The method according to Claim 1, comprising a first stage of scanning the

image and labeling with provisional identification information, the first stage

30   including the step of inputting and the step of labeling,

wherein the step of inputting of the first stage includes inputting, together

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with the pixel block, an adjacent pixel group including pixels that are adjacent to the pixel block and have already been labeled with the provisional identification information, and

the step of labeling of the first stage includes the steps of:

5 inheriting, when the adjacent pixel group includes inheritable provisional identification information, the inheritable provisional identification information as the common identification information;

recording, when the adjacent pixel group includes other inheritable provisional identification information, connecting information for the inherited

10 provisional identification information and non-inherited provisional identification information; and

setting, when the adjacent pixel group does not include inheritable provisional identification information, new provisional identification information as the common identification information.

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5. The method according to Claim 4, further comprising:

a second stage of labeling with real identification information showing image elements, after the first stage,

wherein the second stage includes the step of inputting and the step of

20 labeling that are independent of the steps of inputting and labeling of the first stage respectively, and

the step of labeling of the second stage includes setting the real identification information that is common to pixel blocks in a connecting relationship by the connecting information, as the common identification

25 information.

6. The method according to Claim 4, wherein in the step of inputting of the first stage, the pixel block composed of four pixels that are adjacent to one another in two dimensions and the adjacent pixel group composed of six pixels

30 that are adjacent to two adjacent edges of the pixel block are inputted, and

in the step of labeling of the first stage, when both the pixel block and the

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adjacent pixel group include pixels that constitute an image element in which pixels are consecutive, the provisional identification information included in the adjacent pixel group is inheritable.

7. The method according to Claim 4, wherein in the step of inputting of the first stage, at least one pixel block and the adjacent pixel group including pixel blocks that are adjacent to the at least one pixel block are inputted, and

in the step of labeling of the first stage, when both the at least one pixel block and the adjacent pixel group include pixels that are the subjects for grouping, the provisional identification information included in the adjacent pixel group is inheritable.

8. The method according to Claim 4, wherein in the step of inputting of the first stage, a large pixel block composed of four pixel blocks that are adjacent to one another in two dimensions and the adjacent pixel group composed of six pixel groups that are adjacent to two adjacent edges of the large pixel block are inputted, and

in the step of labeling of the first stage, when both the large pixel block and the adjacent pixel group include pixels that are the subjects for grouping, the provisional identification information included in the adjacent pixel group is inheritable.

9. The method according to Claim 8, further comprising a second stage for labeling image elements with real identification information, after the first stage, the second stage including the step of inputting and the step of labeling that are independent of the step of inputting and labeling of the first stage respectively, and

wherein the step of labeling of the second stage includes setting the real identification information that is common to large pixel blocks in a connecting relationship by the connecting information, as the common identification information and labeling all of the pixels that are the subjects for grouping and are included in the large pixel block.

10. A method of analyzing an image, including the steps of:

inputting a pixel block, which includes a limited number of pixels that are adjacent to one another in more than one dimension, as a single unit from data including a plurality of pixels for forming an image;

labeling, based on binarized pixels, all on-pixels or all off-pixels that are subject for grouping included in a pixel block with common identification information; and

calculating characteristic values of respective image elements by repeatedly carrying out an operation in units that include at least one pixel block.

11. The method according to Claim 10, further including a step of calculating a block characteristic value that contributes to a characteristic value of an image element, the step of calculating a block characteristic value being performed in parallel with the step of labeling and in units of the pixel blocks under labeling.

12. The method according to Claim 11, wherein the step of labeling includes scanning the image for labeling with provisional identification information.

13. The method according to Claim 11, wherein the calculating a block characteristic value includes calculating the block characteristic value based on multivalue pixels included in the pixel block under labeling.

14. The method according to Claim 11, wherein in the inputting, the pixel block composed of four pixels adjacent to one another in two dimensions or eight pixels adjacent to one another in three dimensions is inputted as a single unit.

15. The method according to Claim 11, wherein in the step of inputting, in addition to the pixel block composed of four pixels adjacent to one another in two dimensions, a large pixel block composed of four pixel blocks adjacent to one another in two dimensions is inputted as another single unit, and

in the step of labeling, all on-pixels or all off-pixels that are subject for grouping included in the large pixel block are labeled with the common identification information.

5   16.   An image processing method, comprising:

inputting a pixel block, which includes a plurality of pixels that are adjacent to one another in more than one dimension, as a single unit from data including pixels for forming an image;

labeling, based on binarized pixels, all on-pixels or all off-pixels that are

10   subject for grouping and are included in the pixel block with same identification information; and

distinguishing image elements in a labeled image.

17.   A system including:

15   an interface configured for inputting data including a plurality of pixels, which are adjacent in more than one dimension and constitute a pixel block, in parallel from data including pixels for forming an image; and

a labeling processor configured for labeling, based on binarized pixels, all on-pixels or all off-pixels that are subject for grouping and are included in the pixel

20   block with common identification information in parallel.

18.   The system according to Claim 17, wherein the pixel block is composed of four pixels adjacent to one another in two dimensions or eight pixels adjacent to one another in three dimensions.

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19.   The system according to Claim 17, comprising:

a processor including a processing region that includes a plurality of processing elements, a plurality of data paths that operate in parallel being configured by the plurality of processing elements in the processing region,

30   wherein the interface and the labeling processor are configured in the processing region.

20. The system according to Claim 17, comprising:

a first processing system for scanning the image, labeling with provisional identification information, and generating connecting information for the provisional identification information; and

a second processing system for labeling with real identification information showing image elements based on the connecting information,

wherein the first processing system and the second processing system respectively include the interface and the labeling processor,

the labeling processor of the first processing system assigns the provisional identification information as the common identification information for labeling, and

the labeling processor of the second processing system assigns the real identification information as the common identification information for labeling.

21. The system according to Claim 20, comprising:

a reconfigurable processor including a processing region that includes a plurality of processing elements, a plurality of data paths that operate in parallel being configured by the plurality of the processing elements in the processing region, and a control unit for reconfiguring the processing region,

wherein the interface and the labeling processor included in the first processing system and the interface and the labeling processor included in the second processing system are configured at different timing in the processing region.

22. The system according to Claim 17, comprising a first processing system for scanning an image and labeling with provisional identification information,

wherein the first processing system includes the interface and the labeling processor,

the interface of the first processing system is configured to input the pixel block and an adjacent pixel group including pixels that are adjacent to the pixel

block and have already been labeled with the provisional identification information, and

the labeling processor of the first processing system is configured for performing:

5   inheriting, when the adjacent pixel group includes inheritable provisional identification information, the inheritable provisional identification information as the common identification information;

recording, when the adjacent pixel group includes other inheritable provisional identification information, connecting information for the inherited

10   provisional identification information and non-inherited provisional identification information; and

setting, when the adjacent pixel group does not include inheritable provisional identification information, new provisional identification information as the common identification information.

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23.   The system according to Claim 22,

wherein the labeling processor of the first processing system is configured for pipeline processing:

a process that decodes the pixel block and the adjacent pixel group, and

20   a process that labels the pixels for grouping in the pixel block with selected one of the inheritable provisional identification information and the new provisional identification information as the common identification information.

24.   The system according to Claim 22, further comprising

25   a second processing system for labeling with real identification information showing image elements, the second processing system including the interface and the labeling processor that are configured independently of the first processing system,

wherein the labeling processor of the second processing system is

30   configured to set the real identification information that is common to the pixel blocks in a connecting relationship as the common identification information,

based on the connecting information.

25. The system according to Claim 22,

wherein the interface of the first processing system is configured to supply the pixel block composed of four pixels adjacent to one another in two dimensions and the adjacent pixel group composed of six pixels that are adjacent to two adjacent edges of the pixel block to the labeling processor of the first processing system, and

the labeling processor of the first processing system is configured to inhere, when both the pixel block and the adjacent pixel group include pixels that constitute an image element in which pixels are consecutive, the provisional identification information included in the adjacent pixel group.

26. The system according to Claim 22,

wherein the interface of the first processing system is configured to supply a large pixel block composed of four pixel blocks adjacent to one another in two dimensions and the adjacent pixel group composed of six pixel blocks that are adjacent to two adjacent edges of the large pixel block to the labeling processor of the first processing system, and

the labeling processor of the first processing system is configured to inhere, when both the large pixel block and the adjacent pixel group include pixels for grouping, the provisional identification information included in the adjacent pixel group.

27. The system according to Claim 26, further comprising

a second processing system for labeling with real identification information showing image elements, the second processing system including the interface and the labeling processor that are configured independently of the first processing system,

wherein the labeling processor of the second processing system is configured to set, based on the connecting information, the real identification

information that is common to large pixel blocks in a connecting relationship as the common identification information and to label all of the pixels for grouping included in the large pixel block.

5   28.   The system according to Claim 17, further comprising a first processor configured to repeatedly performing an operations in units of at least one pixel block to calculate a characteristic value of each image element.

    29.   The system according to Claim 17, further comprising a second processor
10   configured to, data including a pixel block being supplied to the second processor by the interface in parallel with the labeling processor, calculate a block characteristic value that contributes to a characteristic value of an image element in units of the pixel blocks under labeling.

15   30.   The system according to Claim 29, wherein the second processor is configured to calculate values that contribute to the characteristic values of image elements from multivalue pixels included in pixel blocks under labeling.